MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

DCE5028 – ELECTRICAL MACHINES AND POWER SYSTEMS

(Diploma in Electronics Engineering)

6 MARCH 2019
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 6 pages (excluding the cover page).
2. Answer **ALL** questions. All necessary working steps must be shown.
3. Write all your answers in the answer booklet provided.

Question 1

(a) A ferromagnetic material with relative permeability of 1000 is shown in Figure Q1(a). A coil of 200 turns is wound on the core having cross-sectional area of 100 cm^2. Due to fringing effect, the effective area of the air gap is enlarged by 5%. Find the

(i) current in the coil if a flux of 0.01 Wb is established in the system, and [10 marks]

(ii) flux density in the air gap. [2 marks]

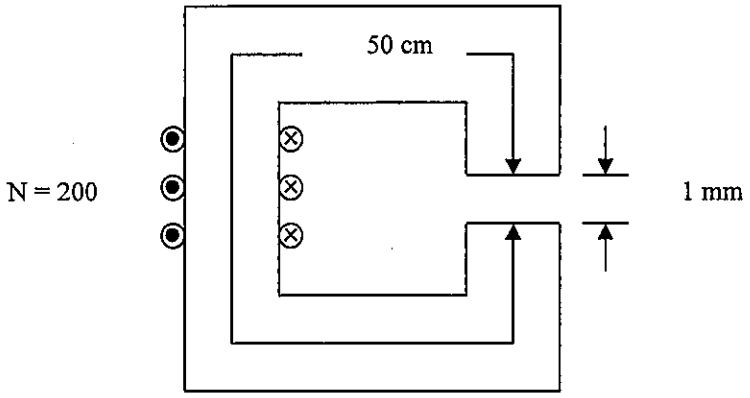

Fig. Q1(a)

(b) A Y-Y connected three-phase power system is shown in Figure Q1(b). The transmission line has an impedance of 0.06 + j 0.12 Ω per phase and the load has an impedance of $15\angle 36.87^0$ per phase. For this power system, determine the

(i) magnitude of the line current, [3 marks]

(ii) magnitude of the load's line and phase voltages [3 marks]

(iii) real, reactive and apparent powers consumed by the load,and [6 marks]

(iv) power factor of the load. [1 mark]

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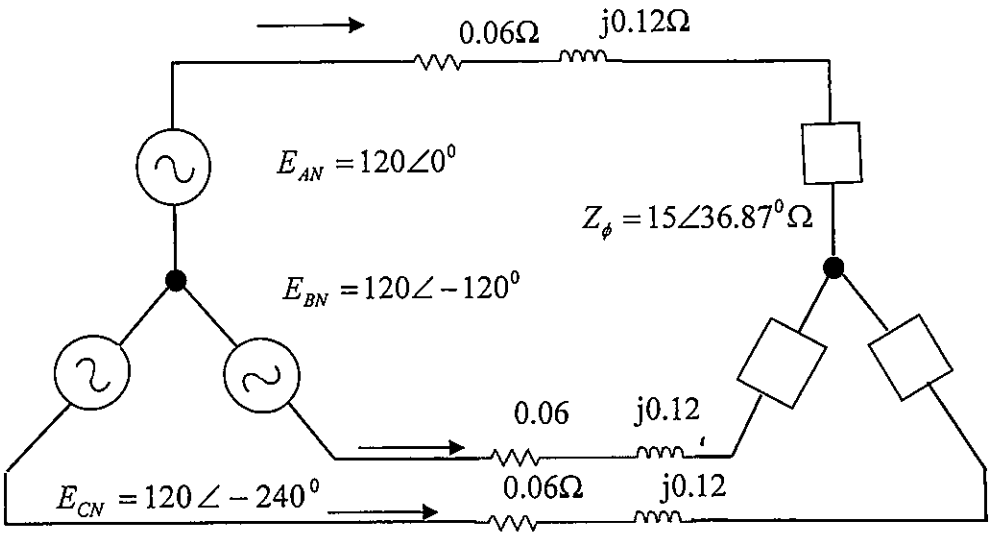


Figure Q1(b)

Question 2

(a) A 6kVA, 300/600V, 50Hz single phase transformer gave the following test results:
Open circuit test: 300V, 0.8A, 70W
Short circuit test: 20V, 12A, 90W

(i) Determine the parameters of excitation branch and the equivalent resistance and reactance if the transformer referred to low voltage side. [7 marks]

(ii) Draw and label the parameters of the equivalent circuit. [2 marks]

(iii) Calculate the efficiency of the transformer if the power factor of the load is 0.8 lagging. [5 marks]

(b) A 220 V DC shunt generator has a full-load current of 86 A. Its armature resistance is 0.05 Ω and a field resistance of 50 Ω. The stray losses are 1 kW.

(i) Draw the equivalent circuit of DC shunt generator [2 marks]

(ii) Compute the generated EMF [4 marks]

(iii) Find the mechanical power required by the machine to deliver full load [3 marks]

(iv) Calculate the efficiency of the generator [2 marks]

Continued...

Question 3

(a) A 208V, 50Hz, 6 poles, Y-connected, three-phase induction motor has the following per phase equivalent circuit parameters:

$\mathbf{R_1 = 0.5\Omega \quad X_1 = 0.9\Omega \quad X_m = 50\Omega \quad R'_2 = 0.3\Omega \quad X'_2 = 1.0\Omega}$

Neglect the effect of the magnetizing resistance Rc. The rotational loss is 200W. The motor runs at 800rpm on full load. Calculate the

(i) slip, [1 mark]

(ii) input current and the power factor, [4 marks]

(iii) input power, [2 marks]

(iv) air-gap power, [2 marks]

(v) power developed, [2 marks]

(vi) output power, and [2 marks]

(vii) efficiency. [2 marks]

(b) A 3-phase synchronous generator produces an open circuit voltage of 6928V when the DC exciting current is 50 A. The AC terminals are then short-circuited, and the line current is found to be 800A. Assume the armature resistance is negligible. Calculate the

(i) synchronous reactance per phase, and [4 marks]

(ii) terminal voltage if three 12 Ω resistances are Wye connected across the terminals. [6 marks]

Continued...

Question 4

(a) A simple power system is shown in Figure Q4. This system contains a 480V generator connected to an ideal 1:10 step-up transformer, a transmission line, an ideal 20:1 step-down transformer, and a load. The impedance of the transmission line is $20 + j60\Omega$, and the impedance of the load is $10\angle 30^{\circ}\Omega$. The base values for this system are chosen to be 480V and 10kVA at the generator.

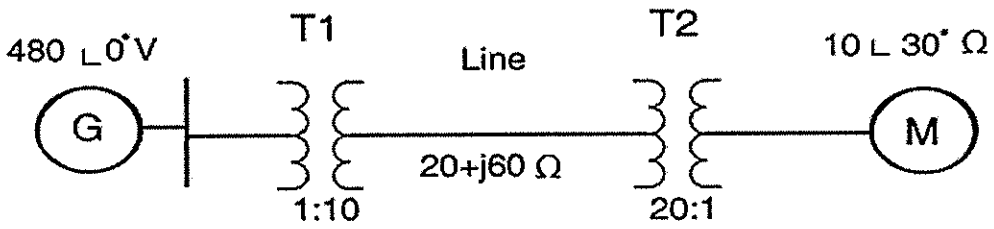


Figure Q4

(i) Find the base voltage, current and impedance at every section of the power system. Duplicate the Table Q4 to your answer booklet and fill the remaining empty column with your answer.

Table Q4

	S_{Base}	V_{Base}	I_{Base}	Z_{Base}
Generator section	10kVA	480V		
Line section	10kVA			
Load section	10kVA			

[8 marks]

(ii) Draw the per unit impedance diagram of the system and determine the per unit values of all components in the diagram. [6 marks]

Continued...

Question 4

(b) What is a fuse? Describe how a fuse can protect electrical equipment from damage. State its disadvantage. [6 marks]

(c) Briefly explain what is pick up current and how it works? An over-current relay having a current setting of 130% is connected to a supply circuit through a current transformer. The rated secondary current of C.T. is 8 A. Determine the pick-up current. [5 marks]

End of page.

Appendix

Magnetic Circuit

$\mu_0 = 4\pi \times 10^{-7}$ $\quad R_c = \dfrac{l_c}{\mu_c A_c}$

$\mathbf{B} = \mu_r \mu_0 \mathbf{H}$

Three-phase Circuit

Wye-connection

$I_{\phi g} = I_L = I_{\varphi L}$

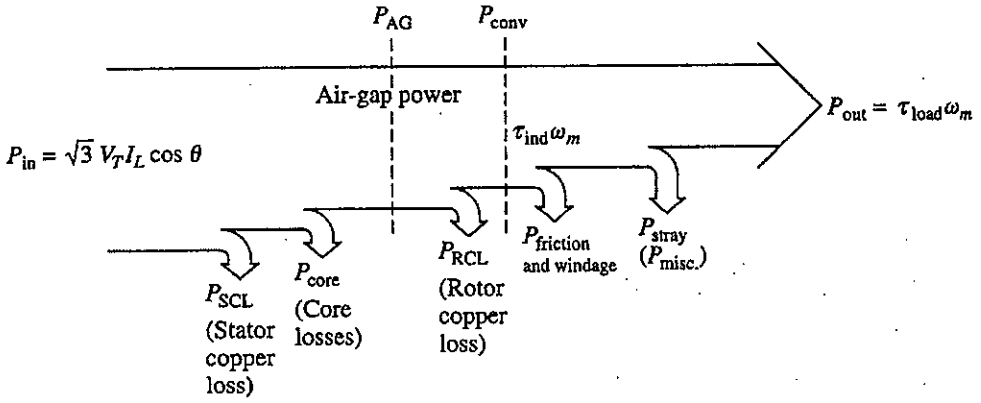
$E_L = \sqrt{3} V_\phi$

Star-connection

$V_\phi = E_L$

$I_L = \sqrt{3} I_\phi$

Induction Machines



Synchronous Machines

% regulation = $(E_o - V)/V \times 100$

Per-unit Value

$$I_{Base} = \left(\frac{S_{Base}}{V_{Base}} \right)$$

$$Z_{Base} = \frac{V_{Base}^2}{S_{Base}}$$

$$Z_{pu}^{new} = Z_{pu}^{old} \left(\frac{S_B^{new}}{S_B^{old}} \right) \left(\frac{V_B^{old}}{V_B^{new}} \right)^2$$